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"HARD" POMERON in "SOFT" PROCESSES at HIGH ENERGY.

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Abstract

An attempt is made to give a consistent description of high energy hadron interactions starting with the physical assumption that only "hard" processes contribute to the Pomeron structure. Using the main properties of a "hard" Pomeron in perturbative QCD we generalize the eikonal approximation widely used to describe the shadowing corrections for both hadron and nucleus scattering at high energy.

I. The main idea.

Calculations of large-cross - section physics at high energy are usually regarded as dirty since there is a widespread delution that it is impossible to develop any theoretical approach to such processes based on our microscopic theory - QCD. It is widely believed that the gap between current phenomenological models for high energy hadron and/or nucleus scattering and QCD is so big that it is difficult to see any interrelation between them. The main goal of this paper is to develop an approach that is based on QCD and establishes a very transparent relationship between high energy "soft" scattering and our microscopic theory.

However let us first of all summarize that experience that we got from description of the experimental data working with a number of model mostly based on reggeon approach to high energy collisions. The common features of all model we can express formulating two principles of success:

1. *In the model you have to introduce Pomeron and take into account two or better many Pomeron exchanges.*

2. *You need to specify what is the Pomeron strucrture incorporating in the Pomeron (Semi)Hard porocess in QCD and "soft" phenomenology.*

I would like to change these guiding principles on one new physical assumption and one principle of strategy to construct the first approach for "soft" processes based on QCD.

1. *Our key assumption is that only production of "hard" partons with $p_t \geq Q_0 \geq 1GeV$ contribute to the Pomeron structure.*

2. *Starting from QCD Pomeron we will be able to take into account Pomeron - Pomeron and Pomeron - Hadron interactions regenerating the Reggeon Field Theory based on QCD.*

Introducing new scale Q_0 we can describe the Pomeron in the framework of perturbative QCD since the coupling QCD constant is small enough $(\alpha_s(Q_0^2) \ll 1)$. However I would like to answer one natural question before I'll discuss the structure of the QCD Pomeron in some details.

Indeed, it seems strange that I would like to discuss problem of " hard" contribution to the Pomeron again since there is a rich literature [1] in which an attempt to take into account both "soft" and "hard" processes has been proposed. Unfortunately the approach developed in ref. [1] is inconsistent since the expression for the inclusive cross section has been used for the "hard" contribution to the total inelastic cross section (see ref. [2] for the relevant critisism on this point). This is a reason why we have to go back and try to develop a selfconsistent approach based on some new physical assumption. I view this paper as a first try in this direction.

II. Experimental Support.

Let me list the arguments that show that the assumption that only "hard" processes contribute to the Pomeron structure is not so crazy as it seems to be at first sight.

1. In any attempt to fit the experimental data, the slope of the Pomeron trajectory (α') turns out to be very small, at least not bigger than $\alpha' = 0.25\ GeV^{-2}$ [3] [4][5] We use the following notation for the Pomeron trajectory $\alpha_P(t = -q_t^2) = 1 + \Delta + \alpha' t$.

2. The experimental slope of diffractive dissociation in the system of secondary hadrons with large mass is approximately two times smaller than the slope for the elastic scattering. In terms of Pomeron phenomenology this fact results in the small proper size of the triple Pomeron vertex (G_{3P}). To a first approximation, we can assign a zero slope for the triple Pomeron vertex so as to describe the experimental data on diffraction dissociation.

3. The idea that gluons inside a hadron are confined in the volume of smaller radius ($R_G \approx 0.1 Fm \ll R_h \sim 1 Fm$) is still a working hypothesis which helps to describe the experimental data (see ref. [3] for the details).

4. The introduction of "semihard" processes in QCD [6] which are responsible for the total inclusive cross section of hadron interaction at high energy leads to a value of the total cross section compatible with the geometrical size of the hadron. The assumption that " semihard" processes are responsible for the most part of the total cross section provides the most probable and natural way to describe the matching between "hard" and "soft" processes.

5. Previous experience in multiperipheral models shows that one could describe the global features of the "soft" interaction at high energy provides the main transverse momentum of produced hadrons is large enough (of the order of $1 GeV$).

6. In the eikonal approach, the QCD - Pomeron is able to describe the current experimental data on total and elastic cross section as well as the slope (see ref. [11] for details).

I hope that the above arguments are convincing enough to consider a hard Pomeron as a first approximation to high energy scattering. This hypothesis has at least three big advantages: simplicity, natural matching with QCD at small distances and the obvious possibility to check it experimentally.

III. General Strategy.

Let me discuss the general strategy of this approach. The first step is a review of the main properties of the QCD Pomeron. It will be shown in the next section that the QCD Pomeron has no slope ($\alpha' = 0$) and can be considered as an exchange with definite impact parameter b_t. Moreover, in the leading log approximation the interaction between Pomerons cannot change b_t. This fact allows us to regenerate the old Reggeon Field Theory [7] for the interaction of hard Pomerons, to be discussed in section 5. In this section the new equation for the shadowing (screening) corrections will be discussed as well as solutions to these equation. In conclusion I'll give a resume of the talk.

IV. The "hard" Pomeron in QCD.

We assume that only hard processes contribute to the structure of the Pomeron and introduce the new natural cut off in momentum (Q_0) so that only the production of quarks and gluons with transverse momenta $p_t > Q_0$ are dominant in the Pomeron. Since we assume that the value of Q_0 is so large that $\alpha_s(Q_0^2) \ll 1$ we can use perturbative QCD to calculate Pomeron exchange in the leading log approximation (LLA) considering the following parameters as small ones:

$$\alpha_s(Q_0^2) \ll 1, \quad \alpha_s(Q_0^2) \ln \frac{k_t^2}{Q_0^2} \ll 1, \quad but \quad \alpha_s(Q_0^2) \ln s \gg 1 .$$

The scattering amplitude in the LLA is given by the summation of the perturbative series:

$$f(s,t;k^2,Q_0^2) = \Sigma_n C_n(\alpha_s(Q_0^2)\ln s)^n + O(\alpha_s(Q_0^2);\alpha_s(Q_0^2)\ln\frac{k^2}{Q_0^2}) , \tag{4.1}$$

where k^2 and Q_0^2 are the virtualities of the scattering partons (quarks or gluons).

During the last two decades the sum of eq. (1) has been studied in great detail (see the original papers [8] [9] or several reviews [6] [10] [12]). I am not going to discuss any technicalies here but I collected all essential properties of the QCD Pomeron in Table 1 comparing them with phenomenological Pomeron that even now is still in the market.

This table shows us that we know a lot about the Pomeron structure in QCD. I would like to comment only b_t distribution since namely $\delta(b_t)$ remarkably simplifyes the problem of shadowing corrections. he main property of the impact parameter motion of the parton could be understood directly from the uncertainty principle, since

$$\Delta b_t \, p_t \approx 1 .$$

Table 1.

"Old, good " Pomeron	QCD "Pomeron"
$\sigma_t \propto s^{\epsilon}\,(\,\epsilon \sim 0.08\,)$	$\sigma_t \propto \frac{1}{\sqrt{\ln s}}\, s^{\omega_0}\,(\,\omega_0 \sim 0.5\,)$
$\langle\lvert p_t^2\rvert\rangle = Const(s)$	$\langle\lvert \ln^2 p_t^2\rvert\rangle \propto \alpha_s \ln s$
$P(b_t) \propto s^{\epsilon} e^{-\frac{b_t^2}{4\alpha' \ln s}}$	$P(b_t) \propto s^{\omega_0}\delta(b_t)$
$y_1 > y_2 > y_3 > \ldots > y_i > \ldots > 0$	$y_1 > y_2 > y_3 > \ldots > y_i > \ldots > 0$
$R^{SR}(y_1, y_2) = 0$	$R^{SR} < 0\,(\approx -0.5\,)$ $R^{SR}(y_1, y_2) = R_0\, e^{-\frac{\lvert y_1 - y_2\rvert}{\Delta_{cr}}}\,(\,\Delta_{cr} \sim \frac{1}{\omega_0} \sim 2)$
$R^{SR}(p_{1t}, p_{2t}) = 0$	$R^{SR}(p_{1t}, p_{2t}) \neq 0$ $p_{1t} > \ldots. > p_{it} > \ldots > R_h^{-1}$
$\frac{\sigma_n}{\sigma_t} \propto e^{-\bar{n}}\frac{\bar{n}^n}{n!}$	$\frac{\sigma_n}{\sigma_t} =$ (see ref. [15])

It means that $\Delta b_t \propto \frac{1}{p_t}$ for each emission where p_t is the typical transverse momentum of the parton. As we assumed $p_t > Q_0 \gg 1GeV$ for all produced partons, the displacement of the parton in b_t can be considered as a small one. Moreover, due to the emission of gluons, the mean transverse momenmtum increases at high energy or after $n \gg 1$ emissions. I hope that this discussion illuminates the strict the LLA result (see refs.[9] [12] [13]) that the LLA Pomeron does not depend on the momentum transferred (t). Thus, in the LLA of perturbative QCD, we can consider the Pomeron as being frozen in b_t - space or in other words its exchange is proportional to $\delta(b_t)$.

For the Pomeron exchange $\delta(b_t)$ means that the slope of the Pomeron trajectory (α') is negligably small. Of course, it is so only in the first rough approximation and perturbative QCD is able to describe b_t behaviour in more details (see refs. [9] [13]). However strictly speaking in the LLA we have to restrict ourselves to $\delta(b_t)$ behaviour (see for example ref. [14] where this problem has been discussed).

Now we can formulate what model for the Pomeron structure we are going to discuss as the first approximation to the "hard " Pomeron. Namely, we assume that the Pomeron can be reduced to the simple formula:

$$P(y, b_t) = i\, e^{\omega_0 y}\delta(b_t)\ . \tag{4.2}$$

Since we consider the case when the initial and final virtuality are equal, the over-simplified formula (4.2) does not take into account the power-like behaviour on $\ln s$ in Table 1. Throughout the paper we will use this simplified version,sice it makes all our calculations so transparent that we prefer to use this form so as to clarify the main property of the screening (shadowing) corrections.

V. Shadowing corrections.

In this section we are going to discuss how to incorporate the shadowing (screening) corrections in the framework of the simplified approach to the Pomeron structure given by eq. (4.2). There are two origins of the shadowing (screening) corrections: the interaction between colliding hadrons due to multipomeron exchanges and the interaction between pomerons. The first one is usually taken into account by the eikonal approach which is presently the only method in the market for the description of the shadowing corrections.During the last decade the eikonal approach has resulted in a better understanding of the origin and nature of the shadowing (screening) corrections. So much that it has become a synonym of the shadowing correction in general. This happened partly as a reaction to the failed attempts to account for the pomeron interaction in the framework of the Reggeon Field Theory (RFT) [7]. The main goal of this section, as well as the whole of this paper, is to revive the RFT and to suggest a more general approach than the eikonal one to the problem of shadowing correction.

A. Eikonal Approach.

Let me start with the review of the main ideas and formulas of the eikonal approach that are carried out most compactly in the impact parameter (b_t) representation.

Our amplitudes are normalized as follows:

$$\frac{d\sigma}{dt} = \pi |f(s,t)|^2 \; ; \quad \sigma_{tot} = 4\pi Im f(s,0) \; ,$$

where

$$f(s,t) = \frac{1}{2\pi} \int d\mathbf{b_t} e^{i\mathbf{q}\cdot\mathbf{b_t}} a(b_t,s) \tag{5.1}$$

and

$$a(s,b_t) = \frac{1}{2\pi} \int d\mathbf{q} e^{-i\mathbf{q}\cdot\mathbf{b_t}} f(s,t) \tag{5.2}$$

hence we have : $\sigma_{tot} = 2\int d\mathbf{b_t} Im\ a(s,b_t)$ and $\sigma_{el} = \int d\mathbf{b_t} |a(s,b_t)|^2$

Unitarity requires $Im\ a(s,b_t) \leq 1$. In order to satisfy the unitarity constraint it is convenient to express $a(s,b_t)$ in terms of the complex eikonal function $\chi(s,b_t)$ with (Im $\chi \geq 0$). i.e.

$$a(s,b_t) = i[1 - e^{i\chi(s,b_t)}] \tag{5.3}$$

which ensures that unitarity is restored on summing up all the eikonal multi-particle exchange amplitudes.

All of the above formulas are general and the eikonal model starts with two assumptions:

1. At high energies elastic scattering is essentially diffractive and therefore $Re\chi$ is small. We assume $Re\ \chi \approx 0$, then the amplitude $a(s, b_t)$ is purely imaginary and determined by the opaqueness $\Omega(s, b_t) \equiv Im\,\chi$.

2. The opaqueness

$$\Omega(s, b_t) = \frac{1}{4\pi}\int d^2 b_t e^{-i\mathbf{q}\cdot\mathbf{b}_t} g^2(t) Im P(s,t) = s^{\omega_0}\int \frac{d^2 b_t'}{2\pi} g(b_t - b_t') g(b_t') , \quad (5.4)$$

where all notation are obvious from and $t = -q_t^2$. Here

$$g(b_t) = \frac{1}{2\pi}\int d^2 b_t e^{-i\mathbf{q}\cdot\mathbf{b}_t} g(q_t^2) ,$$

where $g(t)$ is the vertex for the Pomeron - hadron interaction. Eq. (6) establishes the direct relationship between the opaqueness and the Pomeron exchange.

The advantages of the eikonal approach are evident: the exceptional simplicity of the approach and the fact that this approach takes into account the natural scale for the shadowing corrections. It makes this model very attractive and popular. However, it should be stressed that there are no theoretical arguments why this approach should work. The eikonal model looks extraordinarily strange from the point of view of the parton or QCD approach. Indeed, a slight glance at the QCD parton cascade shows us that in spite of the very complicated structure of this cascade, the number of partons drastically increases mostly due to the decay of each particular parton in its own chain of partons. No arguments have been found in QCD why the complicated structure of the parton cascade which could in principle be described as the Pomeron interactions could be reduced to eikonal diagrams. The parton cascade for the eikonal diagrams looks very simple. Namely, it is only the production of the different parton chains by the fast hadron . I would like to draw your attention to the fact that even in the simplest case of the deep inelastic scattering the structure of the partton cascade can be described better by a "fan" diagram than by an eikonal one (see ref. [6] for details).

B. Pomeron interaction in QCD.

In this subsection I am going to discuss "fan" diagrams contribution to hadron - hadron scattering. I consider this problem as the next approximation to reality after the eikonal one. It certainly will teach us how pomeron - pomeron interaction results in the shadowing correction. However, I would first like to make some general remarks on the main features of pomeron interactions. In this subsection I would like to discuss the generalization of the eikonal formulae including Pomeron interaction. The main advantage of QCD in our problem is the fact that we can formulate what we are doing. Our QCD Pomeron is a well established object, namely LLA "ladder" diagrams which lead to eq. (4.2) in the first rough approximation. So in principle we can calculate in QCD the vertices of interaction between three, four and so on, "ladders". In practice only triple "ladder" interactions have been calculated in specific kinematical regions where the virtualities of all interacting partons were large enough (see refs. [16] [17] [18]) as well as the amplitude of the two "ladder" rescattering (see refs.[19][20]). Let me summarize what we have learned from these calculations.

1. In perturbative QCD we can introduce vertices for three and four pomeron interaction, which are local in rapidity.

2. All contributions with integration over small transverse momenta p_t ($p_t < Q_0$) are cancelled. It means that we can justify calculations in perturbative QCD.

3. The vertices γ for triple Pomeron interaction and λ for four Pomeron interaction have different order of magnitude in α_s. Namely, it turns out that

$$\gamma \propto N_c \alpha_s^2 ; \quad \lambda \propto \alpha_s .$$

4. The sign of the pomeron - pomeron scattering amplitude λ corresponds the attractive forces [19] [20] as was duscussed many years ago by B.M. McCoy and T.T. Wu [21].

5. Concerning the b_t - dependence of the pomeron - pomeron interaction vertices we can also consider them as a δ - function in b_t.

Based on this experience with QCD calculations, I would like to suggest the following strategy of approach:

1) We start from the simplest formula of eq. (4.2) for one Pomeron exchange.

2) We introduce the vertices $g(\frac{b_t}{R})$ for the Pomeron interaction with the hadron. In our approach this is the only vertex which dependence on b_t is scaled by hadron radius R.

3) We describe the Pomeron - Pomeron interaction introducing the triple Pomeron vertex(γ) and four Pomeron amplitude (λ) which are local in rapidity and are proportional to $\delta(b_t)$ with respect to any impact parameter related to the interaction.

It is easy to understand that the above approach is the attempt to calculate the scattering amplitude within accuracy $O(\frac{\alpha' \ln s}{R^2})$. In QCD effective α' of the Pomeron trajectory depends on energy ($\alpha' \propto \frac{1}{\sqrt{\ln s}}$, see ref. [13]) and it is proportional to the extra power of coupling constant α_s. Thus we can consider this approach as legitimate try in QCD.

C. Summation of the "fan" diagrams.

To demonstrate the problems that we face in finding the screening correction contributions let me discuss the simplest nontrivial case: summation of the "fan" diagrams only, neglecting even the pomeron rescattering (i.e we consider $\gamma \neq 0$ while $\lambda = 0$).

To solve this problem we develop the same method of auxillary function [1]

$$\Psi(y,x) \;=\; \Sigma_n \, C_n(y) \, x^n \, , \tag{5.5}$$

in which the coefficients $C_n(y)$ constitute the probability amplitude for finding n Pomerons at rapidity y. For $\Psi(y,x)$ it is very simple to write down the equation:

$$-\,\frac{\partial \Psi(y,x)}{\partial y} \;=\; \omega_0 \, x \, \frac{\partial \Psi(y,x)}{\partial x} \;-\; \gamma \, x^2 \, \frac{\partial \Psi}{\partial x} \, . \tag{5.6}$$

This equation is nothing more than a different form of the equation for C_n :

$$-\,\frac{dC_n(y)}{dy} \;=\; \omega_0 n C_n \;-\; \gamma(n-1) C_{n-1} \, . \tag{5.7}$$

The physical meaning of eq. (5.7) is clear : the first term describes the propagation of Pomerons which do not interact with each other while the second one annihilates any of the Pomerons in the interval dy, replacing it by two others. The minus sign in front of this term reflects the shadowing (screening) character of the interaction or, in other words, the fact that our scattering amplitude is pure imaginary at high energy.

Eq. (5.6) can be solved and the solution is an arbitrary function of one variable $\Psi(\kappa)$, where

$$\kappa \;=\; \omega_0(Y-y) \;+\; \ln \frac{x}{1 - \frac{\gamma}{\omega_0} x} \, . \tag{5.8}$$

The function $\Psi(\kappa)$ can be found from an initial condition, which for our problem is the following :

$$\Psi(\kappa) \;=\; x \, g(b_t - b_t') \;\; at \;\; y \;=\; Y \, . \tag{5.9}$$

From eq. (5.9) we can find that

$$x \;=\; \frac{e^\kappa}{1 \;+\; \frac{\gamma}{\omega_0} e^\kappa} \;\; and \;\; \Psi \;=\; \frac{g(b_t - b_t') \cdot e^\kappa}{1 \;+\; \frac{\gamma}{\omega_0} e^\kappa} \, . \tag{5.10}$$

[1] As far as I know this method was firstly applied to the problem of the shadowing correction in ref. [22].

Finally to get the answer for the scattering amplitude at fixed impact parameter b_t we need to substitute y = 0 and $x = g(b'_t)$ in the definition of κ and find $\Psi(\kappa)$ from the previous equation. Thus

$$a_{FD}(Y = \ln s, b_t) \;=\; \int \frac{d^2 b'_t}{2\pi} \cdot \frac{g(b_t - b'_t) g(b'_t)}{\frac{\gamma}{\omega_0} + e^{-\omega_0 Y}[\,1 - \frac{\gamma}{\omega_0} g(b'_t)\,]} \,. \qquad (5.11)$$

D. Eikonal + " Fan" diagrams.

It is very instructive to get now the formula for the amplitude that takes into account eikonal and "fan" diagrams together. Such a formula can be written in terms of the opaqueness $\Omega(s.b_t)$ and eq. (6) if

$$\Omega(Y = \ln s, b_t) \;=\; e^{\omega_0 Y} \int \frac{d^2 b'_t}{2\pi} g(b_t - b'_t) g(b'_t) \;+\; 2[\,a_{FD}(Y, b_t) \;-\; a_{FD}(Y, b_t, \gamma = 0)\,] \,. \qquad (5.12)$$

The above expression for Ω takes into account in a correct way the fact that two sets of the "fan" diagrams with many pomeron interaction coupled to top or bottom part of the diagram have the same common part - one Pomeron exchange.

E. Pomeron interaction (General case).

In this section I am going to consider the general case and sum up all diagrams, taking into account both the pomeron - pomeron rerscattering (λ) and the pomeron splitting into two pomerons (γ^+) as well as the pomeron annihilation (γ^-).

The first question that arises is why we neglect the more complicated interactions among pomerons,for example the one pomeron transition to three or even more pomerons. To answer these questions we need to recall that in QCD we have the following order of the magnitudes for our basic interactions:

$$g \propto \alpha_s \,; \quad \omega_0 \propto N_c \alpha_s \,; \quad \lambda \propto \alpha_s \,; \quad \gamma^- \sim \gamma^+ \propto N_c \alpha_s^2 \,.$$

Summing diagrams with λ and γ we make an attempt to calculate the high energy amplitude within the accuracy of the order of $O((\alpha_s^3 \ln s)^n)$. Indeed, if we consider the following set of the small parameters: Using the estimates of different Pomeron -Pomeron interaction (see section 5.B we can reduce our problem to the summation of the diagrams withγ and λ interaction between Pomerons in the kinematical region

$$\alpha_s \ll 1 \,; \quad \alpha_s \ln s \gg 1 \,; \quad \alpha_s^2 \ln s \sim 1 \,.$$

The reggeon diagrams give us the possibility to take into account in a constructive way the factorization property of QCD that is very general, at least more general than any leading log approximations.

The equation for the auxiliary function Ψ for the general set of the diagrams can be written in the form:

$$-\frac{\partial \Psi(Y-y,x)}{\partial y} = \tag{5.13}$$

$$\omega_0\, x\, \frac{\partial \Psi(Y-y,x)}{\partial x} + \lambda\, x^2\, \frac{\partial^2 \Psi(Y-y,x)}{\partial x^2} - \gamma^+\, x^2\, \frac{\partial \Psi(Y-y,x)}{\partial x} + \gamma^-\, x\, \frac{\partial^2 \Psi(Y-y,x)}{\partial x^2}\,.$$

The solution of the above equation has been discussed in details in ref.[15]. Here I would like only to stress that this equation solves the general problem of so called unitarization or in other words gives the way to calculate the shadowing correction within guaranteed theoretical accuracy.

VI. Conclusions.

Concluding the paper I would like to repeat once more that an attempt was made in this paper to regenerate the Reggeon Calculus as a way to take into account the pomeron - pomeron interaction to understand the origin and the main property of shadowing (screening) corrections. The approach is based on two principle assumptions:

1. Only "hard" processes with the typical scale of the transverse momentum of the order of $Q_0 \gg \mu$ such as $\alpha_s(Q_0^2) \ll 1$ contribute to the structure of the Pomeron.

2. We can introduce vertices for pomeron - pomeron interactions which are local in rapidity and in the impact parameter.

Both assumptions look very natural from experience in perturbative QCD calculations as well as from current experimental information. However we need a much more detailed study of the above assumptions.

In particular we have to redo all description of the experimental data in the eikonal model to estimate the value of the triple Pomeron vertex as well as the Pomeron - Pomeron scattering amplitude. This task became even more urgent in connection with the new CDF data on total, elastic and diffraction dissociation cross sections [23] that cannot be fitted in the eikonal model in a natural way [24]. The first estimate of the value of the triple Pomeron vertex [24] shows that the corrections described by eq. (28) is not too small and the ratio $\frac{\gamma}{\omega_0}$ is of the order of $\frac{1}{4}$. Unfortunately only after finishing this job we will be able to give the prediction that could be check experimentally. However, the first qualitative prediction is obvious: the shadowing correction in our approach turns to be much stronger than in the eikonal model. This prediction is in perfect qualitative agreement with new CDF data [23].

I would like to recall you that the main goal of this paper for me was to convince the reader that the calculation of the shadowing corrections could be formulated as a theoretical problem with a restricted number of assumptions that could be checked experimentally. I will be happy if somebody will find arguments against my approach since such a discussion will be able to promote a deeper understanding of the pro It is wortwhile mentioning that the above approach is only the first step in the development of a selfconsistent theoretical approach to high energy interaction based on QCD. The next step will be an attempt to take into account both "hard" and "soft" processes (see ref. [25] for a hint on how we could deal with this problem).

At the very end of this paper I would like to note that the technique developed in section 3 can be used also in a more phenomemological approach without any reference to QCD if we assume that the slope of the Pomeron trajectory (α') as well as the slope of all vertices for Pomeron - Pomeron interaction are much smaller than the hadron radius R.

The word POMERON in Russian looks as follows П О М Е Р О Н and means the whole sentence which approximate translation in English sounds like *He is dead, poor guy.* Hope that this talk will cinvince you that it is not true and Pomeron is still with us, giving more and more puzzles for curious mind.

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